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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.

EXAMINER

ART UNIT	PAPER NUMBER

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.	Applicant(s)
09/298,064	Xing et al
Examiner	**Art Unit**
Rudy Zervigon	1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on Mar 16, 2001

2a) ☒ This action is **FINAL.** 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-7 and 17-20 is/are pending in the applica

4a) Of the above, claim(s) _____ is/are withdrawn from considera

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) 1-7 and 17-20 is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirem

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 8, 10

18) ☐ Interview Summary (PTO-413) Paper No(s). _____

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1-4, 6, 7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by P. J. Matsuo et al[1]. P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I, Introduction; Figure 1). Additionally, the variable length of the plasma delivery tube is assessed under numerous conditions such as etch rates (Section III.A.2, p.1803), reaction layer thickness (Section III.C.4, p.1809), atomic (neutral) and reactive (radical) species concentration (Section IV.B, p.1812).

Specifically, and to further illustrate the teachings of P. J. Matsuo et al, the researchers describe:

i. a first reaction chamber ("downstream tubing/lining", Figure 1)

ii. a gas source (fluoromethane, oxygen, nitrogen, Figure 1) coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber

iii. an excitation energy source ("applicator, 2.45GHz", Figure 1) coupled to the first reaction chamber to generate a nitrogen plasma comprising ions and radicals from the nitrogen gas

iv. a second reaction chamber ("processing chamber", Fig.1) adapted to house a substrate at a site in the second reaction chamber

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v. wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the ions (Figure 4) at a plasma generation rate such that the radicals react with the substrate in a process conversion step (film deposition, Refer to Figure 10(d) and section C.1 - "At point (d) N_2 is injected once more and the reaction layer thickness increases again.")

vi. the excitation energy source supplies energy having a microwave frequency to generate a plasma from the nitrogen gas (abstract, first sentence)

vii. The dimensions of the first reaction chamber ("...as the distance from the plasma to the etching region is increased...") are configured such that substantially all of the ions generated by the nitrogen plasma are changed from an ionic state to a charge neutral state within the first reaction chamber (Section IV.B, p.1812)

viii. An apparatus (Figure 1) for exposing a substrate to plasma, comprising a first reaction chamber ("downstream tubing/lining", Figure 1)

ix. means for supplying a nitrogen gas (fluoromethane, oxygen, nitrogen, Figure 1) to the first reaction chamber

x. means for generating a plasma from the nitrogen gas ("applicator, 2.45GHz", Figure 1)

xi. the plasma comprising ions and radicals (definition of plasma)

xii. a second reaction chamber ("processing chamber", Fig.1) having means for housing a substrate

xiii. means for providing the plasma to the second reaction chamber substantially free of ions such that the radicals react with a substrate in a process conversion step (Section IV.B, p.1812)

Item 6.v. is implicitly taught according to Figure 4. As shown in Figure 4, there are non-zero etch rates up to 125cm of first reaction chamber lengths. As such, lifetime of the ions, up to and including these distances, are sufficiently long enough so "that the radicals react with the substrate in a process conversion step".

3. Claims 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Mehrdad M. Moslehi (U.S.Pat. 5,082,517). Mehrdad M. Moslehi identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (column 1, lines 5-15). The control of the composition of neutral and reactive species, and it's importance to plasma processing, is taught by Mehrdad M. Moslehi (column 1, lines 46-68; column 2, lines 37-42; column 4, lines 9-14; column 12, lines 56-68). Specifically, Mehrdad M. Moslehi describes a process conversion (column 4, lines 55-60) system where:

xiv. A system (Figure 1) for reacting a plasma with a substrate

xv. a first chamber (20, Figure 1)

xvi. a gas source (12, Figure 1) coupled to the first chamber comprising

xvii. constituents (12, Figure 1) adapted to react with a substrate (48, Figure 1)

xviii. an energy source coupled to the first chamber (38)

xix. a second chamber (24) configured to house a substrate for processing

xx. a system controller (40) configured to control the introduction of a gas from the gas source into the first chamber and to control the introduction of an energy from the energy source (column 5, lines 43-52)

xxi. a memory coupled to the controller comprising a computer readable medium having a computer-readable program embodied therein for directing operation of the system (implicit; column 5, lines 43-52), the computer readable program comprising:

xxii. instructions for controlling the gas source and the energy source (column 5, lines 43-52) to convert a portion of a gas supplied by the gas source into a plasma comprising plasma ions and radicals (column 4, lines 9-14; column 10, lines 55-60, definition of plasma) and to deliver the plasma to the second chamber substantially (column 4, lines 9-14; column 11, lines 54-63; column 1, lines 46-52) free of ions to react with a substrate in the second chamber in a process conversion step

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over P. J. Matsuo et al[2] as applied to claims 1-4, 6, and 7 above, and further in view of Yamazaki et al (U.S.Pat. 6,130,118). P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I, Introduction; Figure 1). However, P. J. Matsuo et al does not describe a rapid thermal processing chamber as a second chamber.

Yamazaki et al describes a plasma reaction apparatus for film deposition (column2, lines 20-25). Specifically, Yamazaki et al describes a substrate housing rapid thermal processing (RTP) chamber (104, Figure 4; column 6, lines 9-15).

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber.

Motivation for substituting the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber is drawn to the enhanced insulation and thermal conductivity of prepared films (column 6, lines 57-59).

Response to Arguments

6. With regards to responses where "Matsuo does not teach" the claim 1 limitations, Applicant is directed to the claim rejection above.

7. With regards to responses where "Matsuo does not teach a conversion step", the Examiner believes that the following section of the MPEP applies:

MPEP - 2114

Apparatus and Article Claims - Functional Language [R - 1]

APPARATUS CLAIMS MUST BE STRUCTURALLY DISTINGUISHABLE FROM THE PRIOR ART

Claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. In re Danley, 120 USPQ 528, 531 (CCPA 1959). "Apparatus claims cover what a device is, not what a device does ."(emphasis in original) Hewlett - Packard Co . v. Bausch & Lomb Inc ., 15 USPQ2d 1525, 1528 (Fed. Cir. 1990).

8. With regards to the position where "...Matsuo does not describe an apparatus including a second reaction chamber adapted to house a substrate "for film formation processing", or coupling a first reaction chamber to a second reaction chamber with a substrate site separated by a distance equivalent to the lifetime of the ions at a plasma generation rate such that the radicals react with the substrate in a process conversion step."

It is well established in the body of the 35 U.S.C. 102(b) rejection under P. J. Matsuo et al that P. J. Matsuo et al teaches:

"

xxiii. an apparatus (Figure 1)

xxiv. including a second reaction chamber (housing "E/S Chuck", Figure 1) adapted to house a substrate (atop "E/S Chuck", Figure 1)

xxv. "for film formation processing" - Section III.C.1 page 1805, left column. - "...indicates the formation of a progressively thicker modified layer on the unperturbed silicon...", "The formation of another layer takes place now.", "This suggests that the postplasma effect is actually an increase in the reaction layer thickness.".

xxvi. coupling ("Downstream Tubing/ Lining", Figure 1) a first reaction chamber (housing "E/S Chuck", Figure 1) to a second reaction chamber (where plasma is formed in Figure 1 - "Applicator" region) with a substrate site separated by a distance equivalent to the lifetime of the ions at a plasma generation rate ("...as the distance from the plasma to the etching region is increased..." - Section IV.B, p.1812) such that the radicals react with the substrate in a process conversion step (film deposition, Refer to Figure 10(d) and section C.1 - "At point (d) N_2 is injected once more and the reaction layer thickness increases again.").

"

9. With regards to the position that "...the distance between the first reaction chamber and the substrate site separated by the lifetime of the ions, the ions available at the contact site are minimized so that predominantly radicals are available for reaction with a substrate as described in the application." - P. J. Matsuo et al establishes the foundations for the relationship of charge and uncharged species in the plasma environment according to "The separation distance and design of the transport region encompass some important parameters. The separation distance, lining, and geometry play a *major* role in which *reactive* species survive and reach the processing chamber." (Section III.A.2). As such, P. J. Matsuo et al establishes the relationship between "separation distance" to the reaction chamber and the influence on the distribution, or concentration, of "reactive species" which also implies unreactive species if, my material balance, species are either reactive or nonreactive (inert).

P. J. Matsuo et al also, as stated above, teaches "a nitrogen gas" as claimed in the discussion towards the end of Section III.A.2 and, in addition, in Section III.C.1 page 1805, left column.

10. With regards to responses where "Moslehi does not describe a system controller configured to control the introduction of a gas from the gas source into the first chamber and to control the introduction of an energy from the energy source, a memory coupled to the controller comprising a computer readable medium having a computer-readable program embodied therein for directing operation of the system, and instructions for controlling the gas source and the energy source to convert a portion of a gas supplied by the gas source into a plasma comprising plasma ions and radicals, and to deliver the plasma to the second chamber substantially free of ions to react with a substrate in the second chamber in a process conversion step", Applicant is directed to the claim rejection above.

11. Applicant's position that "Moslehi teaches delivering both charged and neutral species to a process chamber" undermines Applicant's position where "...a plasma from a first chamber to a second chamber substantially free of ions...".

12. No response to the Claim 5 rejection under 35 U.S.C. 103(a) as being unpatentable over P. J. Matsuo et al[3] as applied to claims 1-4, 6, and 7 above, and further in view of Yamazaki et al (U.S.Pat. 6,130,118) is recorded.

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[3] *J.Vac.Sci.Technol.* A **15**(4), Jul/Aug 1997

Conclusion

13. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examine should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. Th examiner can normally be reached on a Monday through Thursday schedule from 8am through 7p The official after final fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry general nature or relating to the status of this application or proceeding should be directed t Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner ca be reached please contact the examiner's supervisor, Gregory L Mills, at (703) 308-1633

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